

?s ((magneto? or magnetic) (3n) ((random(2w)memory) or (memory(2n)cell)) or mram) and (pin? or shield?)

Your SELECT statement is:

s ((magneto? or magnetic) (3n) ((random(2w)memory) or (memory(2n)cell)) or mram) and (pin? or shield?)

Items	File
10	2: INSPEC_1969-2001/Sep W2
4	8: Ei Compendex(R)_1970-2001/Sep W2
11	34: SciSearch(R) Cited Ref Sci_1990-2001/Sep W2
1	94: JICST-EPlus_1985-2001/Aug W2
1	103: Energy SciTec_1974-2001/Aug B2
7	144: Pascal_1973-2001/Sep W2
Examined	50 files
38	340: CLAIMS(R)/US PATENT_1950-01/Sep 04

### Status: Break Sent.

?b 2,8,94,103,144;s ((magneto? or magnetic) (3n) ((random(2w)memory) or (memory(2n)cell)) or mram) and (pin? or shield?)

12sep01 09:44:36 User264704 Session D50.2  
\$10.58 8.468 DialUnits File411  
\$10.58 Estimated cost File411  
\$0.75 TYMNET  
\$11.33 Estimated cost this search  
\$11.34 Estimated total session cost 8.672 DialUnits

SYSTEM:OS - DIALOG OneSearch

File 2:INSPEC 1969-2001/Sep W2  
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File 8:Ei Compendex(R) 1970-2001/Sep W2  
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**\*File 8: New price changes effective May 1, 2001. See Help Rates8.**

Truncate CC codes for complete retrieval.UDs were adjusted.

File 94:JICST-EPlus 1985-2001/Aug W2  
(c)2001 Japan Science and Tech Corp(JST)

**\*File 94: There is no data missing. UD's have been adjusted to reflect the current months data. See Help News94 for details.**

File 103:Energy SciTec 1974-2001/Aug B2  
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**\*File 103: For updates please see Help News103.**

For access restrictions, see HELP RESTRICT.

File 144:Pascal 1973-2001/Sep W2  
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Set	Items	Description
	345716	MAGNETO?
	1453592	MAGNETIC
	374231	RANDOM
	301361	MEMORY
	8825	RANDOM(2W)MEMORY
	301361	MEMORY
	1596422	CELL
	6481	MEMORY(2N)CELL
	296	(MAGNETO? OR MAGNETIC) (3N) (RANDOM(2W)MEMORY OR MEMORY(2N)CELL)
	199	MRAM
	275253	PIN?
	142960	SHIELD?
S1	23	((MAGNETO? OR MAGNETIC) (3N) ((RANDOM(2W)MEMORY) OR (MEMORY(2N)CELL)) OR MRAM) AND (PIN? OR SHIELD?)

?rd

...completed examining records

S2 17 RD (unique items)  
?t s2/full/all

2/9/1 (Item 1 from file: 2)

DIALOG(R)File 2:INSPEC

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6883427 INSPEC Abstract Number: A2001-09-7550S-002, B2001-05-3120B-168

Title: **Magnetostatic coupling in spin dependent tunnel junctions**

Author(s): Dexin Wang; Daughton, J.M.; Reed, D.; Wang, W.D.; Jian-Qing Wang

Author Affiliation: Nonvolatile Electron. Inc., Prairie, MN, USA

Journal: IEEE Transactions on Magnetics Conference Title: IEEE Trans. Magn. (USA) vol.36, no.5, pt.1 p.2802-5

Publisher: IEEE,

Publication Date: Sept. 2000 Country of Publication: USA

CODEN: IEMGAQ ISSN: 0018-9464

SICI: 0018-9464(200009)36:5:1L.2802:MCS;1-J

Material Identity Number: I101-2001-001

U.S. Copyright Clearance Center Code: 0 7803 5943 7/2000/\$10.00

Conference Title: INTERMAG 2000 Digest of Technical Papers. 2000 IEEE International Magnetics Conference

Conference Date: 9-13 April 2000 Conference Location: Toronto, Ont., Canada

Document Number: S0018-9464(00)08756-2

Language: English Document Type: Conference Paper (PA); Journal Paper (JP)

Treatment: Applications (A); Experimental (X)

Abstract: Spin dependent tunneling materials have high potential for **MRAM**, read head, and magnetic field sensor applications because of their superior properties of high sensitivity, low power, and small size. However, for some of these applications, magnetic coupling field between the two magnetic layers has to be reduced in order to take full advantage of these superior properties. A parallel coupling field of 6.7 Oe is obtained by measuring the offset of the minor hysteresis loops of the free layers in typical spin valve like SDT structures. Calculation using Neel's formula and parameters from TEM images yield higher coupling fields than experimentally observed, which suggests that the magnetic roughness is less than what is shown by the contrast in the TEM images. Synthetic antiferromagnet **pinned** layers help to reduce the parallel coupling, but not enough to null it out. SDT devices were fabricated by RF sputtering and photolithography patterning. On patterned devices, the effective coupling field can be made as small as 0.5 Oe, which is likely due to the cancellation of the Neel coupling and the fringe field coupling. (11 Refs)

Subfile: A B

Descriptors: magnetic film stores; magnetic heads; magnetic hysteresis; magnetic multilayers; magnetic sensors; Neel temperature; spin valves; tunnelling

Identifiers: magnetostatic coupling; spin dependent tunnel junctions; **MRAM**; read head; magnetic field sensor; magnetic layers; parallel coupling field; minor hysteresis loops; spin valve like SDT structures; Neel's formula; TEM images; coupling fields; magnetic roughness; synthetic antiferromagnet **pinned** layers; RF sputtering; photolithography patterning

Class Codes: A7550S (Magnetic recording materials); A0755 (Magnetic instruments and techniques); A7570P (Enhanced magnetoresistance in magnetic films and multilayers); B3120B (Magnetic recording); B3110M (Magnetic multilayers); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B3120N (Magnetic thin film devices); B7230 (Sensing devices and transducers)

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2/9/2 (Item 2 from file: 2)

DIALOG(R)File 2:INSPEC

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6593627 INSPEC Abstract Number: B2000-06-3120J-022

**Title: Spin dependent tunneling devices fabricated for magnetic random access memory applications using latching mode**

**Author(s):** Wang, D.; Tondra, M.; Pohm, A.V.; Nordman, C.; Anderson, J.; Daughton, J.M.; Black, W.C.

**Author Affiliation:** Nonvolatile Electron. Inc., Eden Prairie, MN, USA

**Journal:** Journal of Applied Physics Conference Title: J. Appl. Phys. (USA) vol.87, no.9, pt.1-3 p.6385-7

**Publisher:** AIP,

**Publication Date:** 1 May 2000 **Country of Publication:** USA

**CODEN:** JAPIAU **ISSN:** 0021-8979

**SICI:** 0021-8979(20000501)87:9:1/3L.6385:SDTD;1-E

**Material Identity Number:** J004-2000-009

**U.S. Copyright Clearance Center Code:** 0021-8979/2000/87(9)/6385(3)/\$17.00

**Conference Title:** 44th Annual Conference on Magnetism and Magnetic Materials

**Conference Date:** 15-18 Nov. 1999 **Conference Location:** San Jose, CA, USA

**Document Number:** S0021-8979(00)62508-2

**Language:** English **Document Type:** Conference Paper (PA); Journal Paper (JP)

**Treatment:** Applications (A); Experimental (X)

**Abstract:** Spin dependent tunneling (SDT) devices were fabricated as building blocks for **magnetic random access memory (MRAM)** applications using latching electronics. The basic SDT structure was NiFeCo/Al/sub 2/O/sub 3//CoFe/IrMn deposited using rf diode sputtering. The SDT structures and the word and torque coils were patterned using standard photolithography techniques. The junction magnetoresistance was 25.6%, the switching field was 12 Oe, the junction resistance-area product was 116 k  $\Omega \mu\text{m}^2$ , and the **pinning** field was 150 Oe. There were two legs of SDT resistors in a latch cell, with each leg consisting of at least one pair of junctions. The basic latching function of the devices was evaluated using external electronics. The two memory states per cell were demonstrated by passing a current of 22 mA with both polarities through the on-chip word coil. This translates to a field efficiency of about 1 Oe/mA for the word coil, which can be further improved by adding a magnetic keeper layer. The raw output voltage change was 21 mV for a SDT cell with four junctions and 4.5 k  $\Omega$  resistance in each leg using a 50  $\mu\text{A}$  sense current. These results show great potential for SDT materials to be used in high speed and low power **MRAM** applications with latching mode. (8 Refs)

**Subfile:** B

**Descriptors:** magnetic film stores; magnetic multilayers; magnetoresistive devices; photolithography; random-access storage; sputtered coatings; tunnelling

**Identifiers:** spin dependent tunneling devices; **MRAM** applications; latching mode; **magnetic random access memory**; RF diode sputtering; photolithography techniques; junction magnetoresistance; switching field; junction resistance-area product; **pinning** field; external electronics; memory states; on-chip word coil; field efficiency; magnetic keeper layer; raw output voltage change; NiFeCo; Al/sub 2/O/sub 3//CoFe; IrMn

**Class Codes:** B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B1265D (Memory circuits); B3120N (Magnetic thin film devices)

**Chemical Indexing:**

NiFeCo int - Co int - Fe int - Ni int - NiFeCo ss - Co ss - Fe ss - Ni ss (Elements - 3)

Al2O3 int - Al2 int - Al int - O3 int - O int - Al2O3 bin - Al2 bin - Al bin - O3 bin - O bin (Elements - 2)

CoFe int - Co int - Fe int - CoFe bin - Co bin - Fe bin (Elements - 2)

IrMn int - Ir int - Mn int - IrMn bin - Ir bin - Mn bin (Elements - 2)

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2/9/3 (Item 3 from file: 2)

DIALOG(R) File 2:INSPEC

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6593361 INSPEC Abstract Number: A2000-12-7570P-017, B2000-06-3120J-013

**Title: Curie point written magnetoresistive memory**  
Author(s): Beech, R.S.; Anderson, J.A.; Pohm, A.V.; Daughton, J.M.  
Author Affiliation: Nonvolatile Electron. Inc., Eden Prairie, MN, USA  
Journal: Journal of Applied Physics Conference Title: J. Appl. Phys.  
(USA) vol.87, no.9, pt.1-3 p.6403-5  
Publisher: AIP,  
Publication Date: 1 May 2000 Country of Publication: USA  
CODEN: JAPIAU ISSN: 0021-8979  
SICI: 0021-8979(20000501)87:9:1/3L.6403:CPWM;1-6  
Material Identity Number: J004-2000-009  
U.S. Copyright Clearance Center Code: 0021-8979/2000/87(9)/6403(3)/\$17.00  
Conference Title: 44th Annual Conference on Magnetism and Magnetic  
Materials

Conference Date: 15-18 Nov. 1999 Conference Location: San Jose, CA,  
USA

Document Number: S0021-8979(00)43808-9

Language: English Document Type: Conference Paper (PA); Journal Paper  
(JP)

Treatment: Applications (A); Experimental (X)

Abstract: Memory cells have been fabricated and tested to demonstrate storage in the **pinned** layer of a giant magnetoresistance (GMR) spin valve film. The spin valve was top **pinned** with a FeMn film and gave about 4% GMR ratio. The memory cell consisted of an oblong,  $0.6 \mu\text{m} \times 7.0 \mu\text{m}$  GMR bit with first metal contacts at each end and a perpendicular first and second metal word line passing over the bit. Joule heating due to current pulses through both the memory cell and the word line raised the temperature of the FeMn **pinning** layer above its Neel point. The magnetic field generated by the word line current switched the **pinning** direction, depending on the polarity of the word line current. Sense line currents up to 5 mA provided a half select without disturbing the bit. In combination with a 5 mA sense current, the bit was written with a word current pulse of 190 mA. The improved thermal stability of the **pinned** storage layer memory cell is shown to become necessary as the size of a **magnetoresistive memory cell** drops below about  $0.1 \mu\text{m} \times 0.4 \mu\text{m}$ . (5 Refs)

Subfile: A B

Descriptors: Curie temperature; giant magnetoresistance; iron alloys; magnetic film stores; magnetic thin films; manganese alloys; spin valves; thermal stability

Identifiers: Curie point writing; magnetoresistive memory; memory cells; **pinned** layer storage; giant magnetoresistance spin valve film; FeMn film; first metal contacts; second metal word line; Joule heating; current pulses; sense line currents; word current pulse; thermal stability;  $0.6 \mu\text{m}$ ;  $7.0 \mu\text{m}$ ; 5 mA; 190 mA; FeMn

Class Codes: A7570P (Enhanced magnetoresistance in magnetic films and multilayers); A7570A (Magnetic properties of monolayers and overlayers); A7530K (Magnetic phase boundaries); A7540 (Critical-point effects, specific heats, short-range order in magnetic materials); A7215G (Galvanomagnetic and other magnetotransport effects (metals/alloys)); A7360D (Electrical properties of metals and metallic alloys (thin films/low-dimensional structures)); A7570C (Interfacial magnetic properties); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B3110C (Ferromagnetic materials); B3110M (Magnetic multilayers); B3120B (Magnetic recording); B3120N (Magnetic thin film devices)

Chemical Indexing:

FeMn int - Fe int - Mn int - FeMn bin - Fe bin - Mn bin (Elements - 2)

Numerical Indexing: size  $6.0\text{E}-07 \text{ m}$ ; size  $7.0\text{E}-06 \text{ m}$ ; current  $5.0\text{E}-03 \text{ A}$ ; current  $1.9\text{E}-01 \text{ A}$

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2/9/4 (Item 4 from file: 2)  
DIALOG(R) File 2:INSPEC  
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6161833 INSPEC Abstract Number: B1999-03-3120J-003

**Title: A new spin-valve magnetic memory cell based on patterned**

**single-domain magnetic multilayer NiFe/Cu/Co**

Author(s): Kong, L.; Pan, Q.; Li, M.; Cui, B.; Chou, S.Y.

Author Affiliation: NanoStructure Lab., Princeton Univ., NJ, USA

Conference Title: 56th Annual Device Research Conference Digest (Cat. No.98TH8373) p.50-1

Publisher: IEEE, New York, NY, USA

Publication Date: 1998 Country of Publication: USA viii+145 pp.

ISBN: 0 7803 4995 4 Material Identity Number: XX-1998-03086

Conference Title: 56th Annual Device Research Conference Digest

Conference Sponsor: IEEE Electron Devices Soc

Conference Date: 22-24 June 1998 Conference Location: Charlottesville, VA, USA

Language: English Document Type: Conference Paper (PA)

Treatment: New Developments (N); Practical (P); Experimental (X)

Abstract: Summary form only given. In a conventional spin-valve **magnetic memory cell**, where a nonmagnetic metal is sandwiched between two-magnetic layers, the magnetization of one magnetic layer (the **pinned layer**) is fixed by an anti-ferromagnetic FeMn layer (the **pinning layer**). However, the FeMn can be easily oxidized, creating instability. In this paper, we demonstrate a new spin-valve magnetic cell, where the magnetization of one magnetic layer is fixed through the spontaneous formation of a single-domain due to nanopatterning, and **pinning layers** (such as FeMn) are no longer required. Magnetic multilayer samples with a NiFe(10 nm)/Co(1 nm)/Cu(13 nm)/Co(10 nm)/NiFe(2 nm) structure were deposited on a SiO/sub 2/ substrate using a DC sputtering system. The samples were patterned using nanoimprint lithography and an ion milling process. (0 Refs)

Subfile: B

Descriptors: cobalt; copper; ion beam applications; iron alloys; lithography; machining; magnetic domains; magnetic film stores; magnetic multilayers; magnetic switching; nanotechnology; nickel alloys; spin valves ; spontaneous magnetisation; sputter deposition

Identifiers: spin-valve **magnetic memory cell** ; patterned single-domain magnetic multilayer NiFe/Cu/Co; nonmagnetic metal; magnetic layers; magnetization; **pinned layer**; anti-ferromagnetic FeMn **pinning layer**; FeMn oxidation; instability; spin-valve magnetic cell; spontaneous single-domain formation; nanopatterning; magnetic multilayer samples; NiFe-Co-Cu-Co-NiFe magnetic multilayer structure; SiO/sub 2/ substrate; DC sputtering system; nanoimprint lithography; ion milling process; 10 nm; 1 nm; 13 nm; 2 nm; SiO/sub 2/; NiFe-Co-Cu-Co-NiFe

Class Codes: B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B3120N (Magnetic thin film devices); B3110M (Magnetic multilayers); B0520B (Sputter deposition)

Chemical Indexing:

SiO2 sur - O2 sur - Si sur - O sur - SiO2 bin - O2 bin - Si bin - O bin (Elements - 2)

NiFe-Co-Cu-Co-NiFe int - NiFe int - Co int - Cu int - Fe int - Ni int - NiFe bin - Fe bin - Ni bin - Co el - Cu el (Elements - 2,1,1,1,2,4)

Numerical Indexing: size 1.0E-08 m; size 1.0E-09 m; size 1.3E-08 m; size 2.0E-09 m

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2/9/5 (Item 5 from file: 2)

DIALOG(R) File 2:INSPEC

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5994920 INSPEC Abstract Number: A9818-7570-063, B9809-3120J-014

**Title: Effect of seed layer on the magnetoresistance characteristics in a-CoNbZr-based spin valves**

Author(s): Hae Seok Cho; Ueda, F.; Chunghong Hou; Fujiwara, H.

Author Affiliation: Center for Mater. for Inf. Technol., Alabama Univ., Tuscaloosa, AL, USA

Journal: IEEE Transactions on Magnetism Conference Title: IEEE Trans. Magn. (USA) vol.34, no.4, pt.1 p.1414-16

Publisher: IEEE,

Publication Date: July 1998 Country of Publication: USA

CODEN: IEMGAQ ISSN: 08-9464

SICI: 0018-9464(199807)34:4:1L.1414:ESLM;1-F

Material Identity Number: I101-98006

U.S. Copyright Clearance Center Code: 0018-9464/98/\$10.00

Conference Title: Seventh Joint Magnetism and Magnetic Materials-Intermag Conference

Conference Date: 6-9 Jan. 1998 Conference Location: San Francisco, CA, USA

Language: English Document Type: Conference Paper (PA); Journal Paper (JP)

Treatment: Experimental (X)

Abstract: We have investigated an amorphous-based spin valve structure of NiO(40 nm)/Co(2)/Cu(t)/Co(1.2)/CoNbZr(20) for the application of **magnetic random access memory**. The spin valves were prepared on Si(100) by sputtering, and characterized by XRD, VSM, AFM/MFM, and 4-point probe. To improve GMR characteristics by controlling the interfacial structures of the Co/Cu/Co trilayer, we employed NiFe as a seed layer for NiO and achieved a GMR ratio of 10.7%. The spin valves with the seed layer exhibited lower ferromagnetic coupling between the **pinned** and free layers, lower **pinning** fields, and higher coercivities of the **pinned** layer than the spin valves without a seed layer. These phenomena were discussed mainly in terms of interfacial microstructural change as well as Neel's orange peel model. (13 Refs)

Subfile: A B

Descriptors: amorphous magnetic materials; atomic force microscopy; cobalt alloys; coercive force; giant magnetoresistance; interface structure; magnetic film stores; magnetic force microscopy; magnetic multilayers; magnetoresistive devices; niobium alloys; random-access storage; sputtered coatings; X-ray diffraction; zirconium alloys

Identifiers: spin valves; giant magnetoresistance; seed layer; **magnetic random access memory**; sputtering; Si(100) substrate; XRD; VSM; AFM; MFM; 4-point probe; interfacial structures; ferromagnetic coupling; **pinning** fields; coercivity; Neel's orange peel model; NiO-Co-Cu-CoNbZr; Si

Class Codes: A7570C (Interfacial magnetic properties of films and multilayers); A7550R (Magnetism in interface structures); A7215G (Galvanomagnetic and other magnetotransport effects (metals/alloys)); A7360D (Electronic properties of metallic thin films); A7550K (Amorphous magnetic materials); A6848 (Solid-solid interfaces); A7570F (Magnetic ordering in multilayers); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B3110M (Magnetic multilayers); B3120N (Magnetic thin film devices); B1265D (Memory circuits)

Chemical Indexing:

NiO-Co-Cu-Co-CoNbZr int - CoNbZr int - NiO int - Co int - Cu int - Nb int - Ni int - Zr int - O int - CoNbZr ss - Co ss - Nb ss - Zr ss - NiO bin - Ni bin - O bin - Co el - Cu el (Elements - 2,1,1,1,3,6)

Si sur - Si el (Elements - 1)

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2/9/6 (Item 6 from file: 2)

DIALOG(R) File 2:INSPEC

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5947913 INSPEC Abstract Number: B9808-3120J-002

Title: **Pseudo spin valve** magnetoresistive random access memory

Author(s): Everitt, B.A.; Pohm, A.V.

Author Affiliation: Nonvolatile Electron. Inc., Eden Prairie, MN, USA

Journal: Journal of Vacuum Science & Technology A (Vacuum, Surfaces, and Films) Conference Title: J. Vac. Sci. Technol. A, Vac. Surf. Films (USA) vol.16, no.3 p.1794-800

Publisher: AIP for American Vacuum Soc,

Publication Date: May-June 1998 Country of Publication: USA

CODEN: JVTAD6 ISSN: 0734-2101

SICI: 0734-2101(199805/06)16:3L.1794:PSVM;1-Q

Material Identity Number: D746-98003

U.S. Copyright Clearance Center Code: 0734-2101/98/16(3)/1794(7)/\$15.00

Conference Title: 44th National Symposium of the American Vacuum Society

Conference Date: 20 Oct. 1997 Conference Location: San Jose, CA, USA

Document Number: S0734-2101(98)59903-4

Language: English Document Type: Conference Paper (PA); Journal Paper (JP)

Treatment: Practical (P); Experimental (X)

**Abstract:** **Magnetoresistive random access memory** has many desirable characteristics compared to other nonvolatile memory technologies. These include no inherent wear-out mechanism, very fast switching capability, and relatively few mask layers required for fabrication. We have investigated sub-micron memory cells patterned from asymmetric giant magnetoresistance (GMR) sandwich materials that have 6%-7.5% signal levels, exhibit sharp single-domain-like switching thresholds, and are sensed in a mode that yields a differential output signal effectively twice the intrinsic GMR of the material. The cell is designed so that the thinner of the two magnetic layers reverses freely in a read operation, while the bit state is stored in the thicker magnetic layer whose magnetization switches only upon writing the bit. Due to the high signal level and similarity in transfer characteristic to that of **pinned spin valve** material, we have labeled this cell structure and mode of operation **pseudo spin valve (PSV)**. Experimental PSV memory cells and test structures approximately 0.3  $\mu\text{m}$  in width were patterned and tested, and yielded GMR values of up to about 7.5%. Dependence of the write thresholds on sense line current as well as word and bias line fields was studied and confirmed that two-dimensional cell selection may be used in an array. Single bits exhibited sharp, single-domain-like write threshold characteristics, if properly shaped. Using a single domain model that takes into account static torques on the magnetic layers in a bit, as well as coupling between these layers, transfer curves and switching characteristics that qualitatively match the experimental data were generated. Using the model, properties of conceptual double **pseudo spin valve (DPSV)** cells were also studied. A DPSV cell is comprised of GMR material with three magnetic layers, where either the center layer or one of the two outer layers acts as the storage film. Advantages of DPSV cells include nearly twice the GMR compared with a PSV cell of similar area, as well as lower write thresholds. (17 Refs)

Subfile: B

Descriptors: giant magnetoresistance; magnetic storage; magnetic switching; magnetoresistive devices; random-access storage

Identifiers: **pseudospin valve magnetoresistive random access memory**; switching capability; mask layers; asymmetric giant magnetoresistance sandwich materials; single-domainlike switching thresholds; magnetization switch; write thresholds; sense line current; 2D cell selection; single domain model; RAM

Class Codes: B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B1265D (Memory circuits)

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2/9/7 (Item 7 from file: 2)

DIALOG(R) File 2:INSPEC

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5681787 INSPEC Abstract Number: B9710-3120J-017

**Title:** **Submicron spin valve magnetoresistive random access memory cell**

Author(s): Chen, E.Y.; Tehrani, S.; Zhu, T.; Durlam, M.; Goronkin, H.

Author Affiliation: Phoenix Corp. Res. Lab., Motorola Inc., Tempe, AZ, USA

Journal: Journal of Applied Physics Conference Title: J. Appl. Phys. (USA) vol.81, no.8 p.3992-4

Publisher: AIP,

Publication Date: 15 April 1997 Country of Publication: USA

CODEN: JAPIAU ISSN: 0021-8979

SICI: 0021-8979(19970415)81:8L:3992:SSVM;1-#

Material Identity Number: J004-97015

U.S. Copyright Clearance Center Code: 0021-8979/97/81(8)/3992/3/\$10.00

Conference Title: 41st Annual Conference on Magnetism and Magnetic

## Materials

Conference Sponsor: AIP; IEEE; TMS; Office of Naval Res.; ASTM; APS; American Ceramic Soc

Conference Date: 12-15 Nov. 1996 Conference Location: Atlanta, GA, USA

Document Number: S0021-8979(97)67808-1

Language: English Document Type: Conference Paper (PA); Journal Paper (JP)

Treatment: Practical (P); Experimental (X)

Abstract: Spin valve **magnetoresistive random access memory** cells with widths varying from 1.5 to 0.25  $\mu\text{m}$  and an aspect ratio of length/width more than 10 were fabricated and tested. In general, the switching field of the free magnetic layer was found to be inversely proportional to the width of the cell. Adequate **pinning** was shown for cell width down to 0.75  $\mu\text{m}$ . For 0.5 and 0.25  $\mu\text{m}$  wide cells, the switching field of the free magnetic layer is comparable to the **pinning** field of the other magnetic layer. So the **pinned** magnetic layer rotates with the free magnetic layer. The giant magnetoresistive ratio of the cell drops dramatically. Potentially, this may be a fundamental problem for this memory mode. Solutions are proposed. (6 Refs)

Subfile: B

Descriptors: giant magnetoresistance; magnetic storage; magnetoresistive devices; random-access storage

Identifiers: submicron spin valve **magnetoresistive random access memory cell**; aspect ratio; switching field; free magnetic layer; **pinning**; cell width; **pinned** magnetic layer; giant magnetoresistive ratio; memory mode; 1.5 to 0.25  $\mu\text{m}$ ; FeMn; NiFeCo; Si/sub 3/N/sub 4/; CoFe

Class Codes: B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices)

Chemical Indexing:

FeMn int - Fe int - Mn int - FeMn bin - Fe bin - Mn bin (Elements - 2)

NiFeCo int - Co int - Fe int - Ni int - NiFeCo ss - Co ss - Fe ss - Ni ss (Elements - 3)

Si3N4 int - Si3 int - N4 int - Si int - N int - Si3N4 bin - Si3 bin - N4 bin - Si bin - N bin (Elements - 2)

CoFe int - Co int - Fe int - CoFe bin - Co bin - Fe bin (Elements - 2)

Numerical Indexing: size 2.5E-07 to 1.5E-06 m

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2/9/8 (Item 8 from file: 2)

DIALOG(R) File 2:INSPEC

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5412600 INSPEC Abstract Number: A9624-7340R-001, B9612-2530G-002

Title: **Spin-dependent tunneling in HfO/sub 2/ tunnel junctions**

Author(s): Platt, C.L.; Dieny, B.; Berkowitz, A.E.

Author Affiliation: Dept. of Phys., California Univ., San Diego, La Jolla, CA, USA

Journal: Applied Physics Letters vol.69, no.15 p.2291-3

Publisher: AIP,

Publication Date: 7 Oct. 1996 Country of Publication: USA

CODEN: APPLAB ISSN: 0003-6951

SICI: 0003-6951(19961007)69:15L:2291:SDTH;1-A

Material Identity Number: A135-96042

U.S. Copyright Clearance Center Code: 0003-6951/96/69(15)/2291/3/\$10.00

Document Number: S0003-6951(96)02741-6

Language: English Document Type: Journal Paper (JP)

Treatment: Applications (A); Practical (P); Experimental (X)

Abstract: We identified reactively sputtered HfO/sub 2/ as a particularly good material for making thin insulating barriers for spin-dependent tunnel junctions. This material allows one to form **pinhole**-free tunnel barriers with good transmission of the spin polarization of the tunneling electrons. Magnetic tunnel junctions consisting of a thin layer of HfO/sub 2/ sandwiched between transition metal electrodes (Co and Fe, for instance) exhibit changes of tunnel resistance up to 30% at low temperature as a function of applied field. This effect can be used in a variety of magnetic field sensing applications or in **magnetic random access memory**. (16



Refs)

Subfile: A B

Descriptors: cobalt; hafnium compounds; iron; magnetic sensors; magnetic storage; magnetoresistance; magnetoresistive devices; MIM structures; random-access storage; tunnelling

Identifiers: HfO/sub 2/ tunnel junctions; spin-dependent tunneling; insulating barriers; pinhole -free tunnel barriers; Co-HfO/sub 2/-Fe; magnetic field sensing applications; magnetic random access memory

Class Codes: A7340R (Metal-insulator-metal structures); A7320A (Surface states, band structure, electron density of states); A0755 (Magnetic instruments and techniques); B2530G (Metal-insulator-metal and metal-semiconductor-metal structures); B3120B (Magnetic recording ); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B7230 (Sensing devices and transducers); B7310L (Magnetic variables measurement)

Chemical Indexing:

Co-HfO<sub>2</sub>-Fe int - HfO<sub>2</sub> int - Co int - Fe int - Hf int - O<sub>2</sub> int - O int - HfO<sub>2</sub> bin - Hf bin - O<sub>2</sub> bin - O bin - Co el - Fe el (Elements - 1,2,1,4)

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2/9/9 (Item 9 from file: 2)

DIALOG(R)File 2:INSPEC

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5326450 INSPEC Abstract Number: B9609-3120N-001

Title: Micromagnetic study on write operation in submicron magnetic random access memory cell

Author(s): Asada, H.; Matsuyama, K.; Taniguchi, K.

Author Affiliation: Dept. of Electr. Eng., Kyushu Univ., Fukuoka, Japan

Journal: Journal of Applied Physics Conference Title: J. Appl. Phys. (USA) vol.79, no.8, pt.2B p.6646-8

Publisher: AIP,

Publication Date: 15 April 1996 Country of Publication: USA

CODEN: JAPIAU ISSN: 0021-8979

SICI: 0021-8979(19960415)79:8:2BL.6646:MSWO;1-X

Material Identity Number: J004-96011

U.S. Copyright Clearance Center Code: 0021-8979/96/79(8)/6646/3/\$10.00

Conference Title: Fortieth Annual Conference on Magnetism and Magnetic Materials

Conference Sponsor: AIP; Magnetism Soc. IEEE; et al

Conference Date: 6-9 Nov. 1996 Conference Location: Philadelphia, PA, USA

Language: English Document Type: Conference Paper (PA); Journal Paper (JP)

Treatment: Practical (P); Theoretical (T)

Abstract: In a spin-valve random access memory, the binary bit states of the storage cell are determined by the magnetization direction in the free magnetic layer. The write operation of a submicron memory cell element has been studied by a micromagnetic computation based on an energy minimization scheme, which aids in the chip design. The magnetization of the binary bit states in the element was found to take a single domain structure having the opposite direction of the long-axis component. The mean long-axis component of magnetization of each binary state was  $\pm 0.97$  without external fields. The selective switching of the bit state in the element was performed by the write currents applied into the two level conductors overlying the element for various conditions. The influence of the write currents to the neighboring element on a two-dimensional memory array with a  $1 \times 1 \mu\text{m}$  pitch was also simulated, in order to confirm the selective switching of the memory element. It was found that the selective write current amplitude decreased with an increasing assist current amplitude and the range was extended by the large difference of the transverse magnetic field between the selected and neighboring element. The effect of the exchange interaction from the pinned magnetic layer on the write operation was also discussed. (4 Refs)

Subfile: B

Descriptors: exchange interactions (electron); giant magnetoresistance;

interface magnetism; magnetic domains; magnetic film storage; magnetic switching; magnetisation reversal; magnetoresistive devices; random-access storage

Identifiers: micromagnetic study; write operation; submicron **magnetic random access memory cell**; spin-valve random access memory; binary bit states; storage cell; magnetization direction; free magnetic layer; submicron memory cell element; micromagnetic computation; energy minimization scheme; chip design; single domain structure; long-axis component; selective switching; two level conductors; write currents; two-dimensional memory array; current amplitude; transverse magnetic field; exchange interaction; **pinned** magnetic layer

Class Codes: B3120N (Magnetic thin film devices); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B1265D (Memory circuits)

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2/9/10 (Item 10 from file: 2)

DIALOG(R) File 2:INSPEC

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5248922 INSPEC Abstract Number: B9606-1265D-022

**Title: An IC process compatible nonvolatile magnetic RAM**

Author(s): Tang, D.D.; Wang, P.K.; Speriosu, V.S.; Le, S.; Fontana, R.E.; Rishton, S.

Author Affiliation: IBM Almaden Res. Center, San Jose, CA, USA

Conference Title: International Electron Devices Meeting. Technical Digest (Cat. No.95CH35810) p.997-1000

Publisher: IEEE, New York, NY, USA

Publication Date: 1995 Country of Publication: USA 1026 pp.

ISBN: 0 7803 2700 4 Material Identity Number: XX95-02847

U.S. Copyright Clearance Center Code: 0 7803 2700 4/96/\$4.00

Conference Title: Proceedings of International Electron Devices Meeting

Conference Sponsor: IEEE Electron. Devices Soc

Conference Date: 10-13 Dec. 1995 Conference Location: Washington, DC, USA

Language: English Document Type: Conference Paper (PA)

Treatment: Practical (P); Experimental (X)

Abstract: This paper presents the characteristics of a silicon IC process compatible, nonvolatile memory. The basic storage element is a thin-film stripe that consists of a pair of 9-nm ferromagnetic (NiFe) layers spaced with 2.2-2.5 nm of non-magnetic Cu film. The magnetization, *M*, of one of the layers is **pinned** along the longitudinal direction of the stripe with an antiferromagnetic material (FeMn), while the *M* of the other layer is free to rotate. This structure is known as a spin valve. When the *M*s of the pair are in the same (parallel) direction, the resistance is lower than when they are in the opposite (anti-parallel) direction by 5-8%. This property is well known as the giant **magneto**-resistive effect. The **memory cell** is made up of a storage resistor stripe and the x/y select wires, typically 100 nm thick. The current pulses in the select wires generate a vector sum of magnetic field that switches the cell state. The switching field in the longitudinal direction is lowered when a transverse field is applied. The memory cells were fabricated on thermal oxide on silicon wafers. The sputter deposition and etch process of the spin valve does not affect the leakage nor does it alter the *V<sub>t</sub>* of FETs, and thus may be integrated into the metallization steps of the silicon wafer processing. (0 Refs)

Subfile: B

Descriptors: giant magnetoresistance; magnetic film stores; magnetic multilayers; magnetic switching; magnetoresistive devices; monolithic integrated circuits; Permalloy; random-access storage

Identifiers: IC process compatible nonvolatile magnetic RAM; storage element; thin-film stripe; ferromagnetic NiFe layers; nonmagnetic Cu film; magnetization **pinning**; antiferromagnetic material; spin valve; giant magneto-resistive effect; storage resistor stripe; x/y select wires; switching field; thermal oxide; Si wafer processing; sputter deposition; etch process; metallization steps; magnetoresistive storage; 9 nm; 2.2 to

2.5 nm; FeMn-NiFe-Cu-Ni-SiO/sub 2/-Si

Class Codes: B1265D (Memory circuits); B3120N (Magnetic thin film devices); B3120J (Magneto-acoustic, magnetoresistive, magnetostrictive and magnetostatic wave devices); B2570 (Semiconductor integrated circuits)

Chemical Indexing:

FeMn-NiFe-Cu-NiFe-SiO<sub>2</sub>-Si int - FeMn int - NiFe int - SiO<sub>2</sub> int - Cu int - Fe int - Mn int - Ni int - O<sub>2</sub> int - Si int - O int - FeMn bin - NiFe bin - SiO<sub>2</sub> bin - Fe bin - Mn bin - Ni bin - O<sub>2</sub> bin - Si bin - O bin - Cu el - Si el (Elements - 2,2,1,2,2,1,6)

Numerical Indexing: size 9.0E-09 m; size 2.2E-09 to 2.5E-09 m

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2/9/11 (Item 1 from file: 8)

DIALOG(R) File 8: Ei Compendex(R)

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05831477 E.I. No: EIP01236534782

**Title: Magnetostatic coupling in spin dependent tunnel junctions**

Author: Wang, D.; Daughton, J.M.; Reed, D.; Wang, W.D.; Wang, J.-Q.

Corporate Source: Nonvolatile Electronics Inc., Eden Prairie, MN 55344, United States

Conference Title: 2000 International Magnetism Conference (INTERMAG 2000)

Conference Location: Toronto, Ont, Canada Conference Date: 20000409-20000412

E.I. Conference No.: 58080

Source: IEEE Transactions on Magnetism v 36 n 5 I September 2000 2000. p 2802-2805

Publication Year: 2000

CODEN: IEMGAQ ISSN: 0018-9464

Language: English

Document Type: CA; (Conference Article) Treatment: X; (Experimental)

Journal Announcement: 0106W3

Abstract: Spin dependent tunneling materials have high potential for MRAM, read head, and magnetic field sensor applications because of their superior properties of high sensitivity, low power, and small size. However, for some of these applications, magnetic coupling field between the two magnetic layers has to be reduced in order to take full advantage of these superior properties. A parallel coupling field of 6.7 Oe is obtained by measuring the offset of the minor hysteresis loops of the free layers in typical spin valve like SDT structures. Calculation using Neel's formula and parameters from TEM images yield higher coupling fields than experimentally observed, which suggests that the magnetic roughness is less than what is shown by the contrast in the TEM images. Synthetic antiferromagnet pinned layers help to reduce the parallel coupling, but not enough to null it out. SDT devices were fabricated by rf sputtering and photolithography patterning. On patterned devices, the effective coupling field can be made as small as 0.5 Oe, which is likely due to the cancellation of the Neel coupling and the fringe field coupling. 12 Refs.

Descriptors: \*Magnetic couplings; Tunnel junctions; Magnetostatics; Sensors; Hysteresis; Transmission electron microscopy; Photolithography  
Identifiers: Magnetostatic couplings; Spin dependent tunneling (SDT) materials  
Classification Codes:

701.2 (Magnetism, Basic Concepts & Phenomena); 708.4 (Magnetic Materials); 714.2 (Semiconductor Devices & Integrated Circuits); 931.3 (Atomic & Molecular Physics); 732.2 (Control Instrumentation); 931.2 (Physical Properties of Gases, Liquids & Solids)

602 (Mechanical Drives & Transmissions); 701 (Electricity & Magnetism); 708 (Electric & Magnetic Materials); 714 (Electronic Components & Tubes); 931 (Applied Physics Generally); 932 (High Energy Physics; Nuclear Physics; Plasma Physics); 732 (Control Devices); 801 (Chemistry)

60 (MECHANICAL ENGINEERING, GENERAL); 70 (ELECTRICAL ENGINEERING, GENERAL); 71 (ELECTRONICS & COMMUNICATION ENGINEERING); 93 (ENGINEERING PHYSICS); 73 (CONTROL ENGINEERING); 80 (CHEMICAL ENGINEERING, GENERAL)

2/9/12 (Item 2 from file: 8)

DIALOG(R) File 8: Ei Compendex(R)  
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05825798 E.I. No: EIP01226521584

**Title: A 256Kb 3.0V 1T1MTJ nonvolatile magnetoresistive RAM**

Author: Naji, P.K.; Durlam, M.; Tehrani, S.; Calder, J.; DeHerrera, M.F.

Corporate Source: Motorola Labs. Physical Sciences Research Labs.,  
Chandler, AZ, United States

Conference Title: Digest of Technical Papers - IEEE International  
Solid-State Circuits Conference

Conference Date: 20010205-20010206

Sponsor: IEEE

E.I. Conference No.: 58062

Source: Digest of Technical Papers - IEEE International Solid-State  
Circuits Conference 2001. p 122-123+438

Publication Year: 2001

CODEN: DTPCDE ISSN: 0193-6530

Language: English

Document Type: CA; (Conference Article) Treatment: T; (Theoretical)

Journal Announcement: 0106W2

Abstract: The **magnetoresistive random access memory (MRAM)** based  
on **magnetic** memory elements integrated with CMOS was described. The  
resistance of the MTJ is either at a minimum or maximum level depending on  
the relative polarization, parallel or anti-parallel of the free layer  
with respect to the **pinned** layer. The information stored in a selected  
memory cell is read by comparing its resistance of a reference memory cell  
located along the same wordline. (Edited abstract) 3 Refs.

Descriptors: \*Random access storage; Magnetoresistance; Nonvolatile  
storage; CMOS integrated circuits; Dielectric materials; Polarization

Identifiers: **Magnetoresistive random access memory (MRAM)**

Classification Codes:

722.1 (Data Storage, Equipment & Techniques); 701.2 (Magnetism, Basic  
Concepts & Phenomena); 714.2 (Semiconductor Devices & Integrated Circuits)  
; 708.1 (Dielectric Materials); 701.1 (Electricity, Basic Concepts &  
Phenomena)

722 (Computer Hardware); 701 (Electricity & Magnetism); 714  
(Electronic Components & Tubes); 708 (Electric & Magnetic Materials)

72 (COMPUTERS & DATA PROCESSING); 70 (ELECTRICAL ENGINEERING, GENERAL);  
71 (ELECTRONICS & COMMUNICATION ENGINEERING)

2/9/13 (Item 3 from file: 8)

DIALOG(R) File 8: Ei Compendex(R)

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05082285 E.I. No: EIP98084312161

**Title: Effect of seed layer on the magnetoresistance characteristics in  
a-CoNbZr-based spin valves**

Author: Cho, Hae Seok; Ueda, Fumiomi; Hou, Chunhong; Fujiwara, Hideo

Corporate Source: Univ of Alabama, Tuscaloosa, AL, USA

Conference Title: Proceedings of the 1998 7th Joint Magnetism and  
Magnetic Materials - International Magnetism Conference. Part 1 (of 2)

Conference Location: San Francisco, CA, USA Conference Date:  
19980106-19980109

E.I. Conference No.: 48733

Source: IEEE Transactions on Magnetism v 34 n 4 pt 1 July 1998. p  
1414-1416

Publication Year: 1998

CODEN: IEMGAQ ISSN: 0018-9464

Language: English

Document Type: JA; (Journal Article) Treatment: X; (Experimental)

Journal Announcement: 9809W5

Abstract: We have investigated an amorphous-based spin valve structure of  
NiO(40 nm)/Co(2)/Cu(t)/Co(1.2)/CoNbZr(20) for the application of **magnetic  
random access memory**. The spin valves were prepared on Si(100) by  
sputtering, and characterized by XRD, VSM, AFM/MFM, and 4-point probe. To  
improve GMR characteristics by controlling the interfacial structures of

the Co/Cu/Co trilayer, employed NiFe as a seed layer NiO and achieved a GMR ratio of 10.7%. The spin valves with the seed layer exhibited lower ferromagnetic coupling between the pinned and free layers, lower pinning fields, and higher coercivities of the pinned layer than the spin valves without a seed layer. These phenomena were discussed mainly in terms of interfacial microstructural change as well as Neel's orange peel model. (Author abstract) 13 Refs.

Descriptors: \*Magnetic materials; Magnetoresistance; Cobalt compounds; Ferromagnetism; Magnetic fields; Random access storage; Sputtering; X ray diffraction analysis; Atomic force microscopy; Coercive force

Identifiers: Seed layers; Giant magnetoresistance (GMR); Spin valves; Ferromagnetic coupling

Classification Codes:

708.4 (Magnetic Materials); 701.2 (Magnetism: Basic Concepts & Phenomena); 804.2 (Inorganic Components); 722.1 (Data Storage, Equipment & Techniques); 539.3 (Metal Plating)

708 (Electric & Magnetic Materials); 701 (Electricity & Magnetism); 804 (Chemical Products); 722 (Computer Hardware); 539 (Metals Corrosion & Protection); 801 (Chemical Analysis & Physical Chemistry)

70 (ELECTRICAL ENGINEERING); 80 (CHEMICAL ENGINEERING); 72 (COMPUTERS & DATA PROCESSING); 53 (METALLURGICAL ENGINEERING)

2/9/14 (Item 4 from file: 8)

DIALOG(R) File 8: Ei Compendex(R)

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05082168 E.I. No: EIP98084312044

Title: Characteristics of AP bias in spin valve memory elements

Author: Zhu, Jian-Gang; Zheng, Youfeng

Corporate Source: Carnegie Mellon Univ, Pittsburgh, PA, USA

Conference Title: Proceedings of the 1998 7th Joint Magnetism and Magnetic Materials - International Magnetism Conference. Part 1 (of 2)

Conference Location: San Francisco, CA, USA Conference Date: 19980106-19980109

E.I. Conference No.: 48733

Source: IEEE Transactions on Magnetism v 34 n 4 pt 1 July 1998. p 1063-1065

Publication Year: 1998

CODEN: IEMGAQ ISSN: 0018-9464

Language: English

Document Type: JA; (Journal Article) Treatment: T; (Theoretical)

Journal Announcement: 9809W5

Abstract: Spin valve memory element biased with a pair of antiparallel (AP) coupled ferromagnetic layer was analyzed and modeled via micromagnetic simulation. In an AP structure, an external field results in a torque, causing the antiparallel magnetization (AP) axis to rotate towards the direction orthogonal to the field. In addition, due to its strength difference between the two AP layers, the magnetostatic field from the free layer of the spin valve can lead to irreversible AP axis flipping. This irreversible flipping can be effectively prevented by applying an AF/F exchange pinning to one of the AP layers to overcome the differential field from the free layer. (Author abstract) 4 Refs.

Descriptors: \*Magnetic film storage; Random access storage; Magnetic semiconductors; Ferromagnetic materials; Magnetostatics; Magnetization; Antiferromagnetic materials; Semiconductor device models

Identifiers: Magnetoresistive random access memory (MRAM ); Spin valve memory elements

Classification Codes:

722.1 (Data Storage, Equipment & Techniques); 708.4 (Magnetic Materials); 712.1 (Semiconducting Materials); 802.3 (Chemical Operations); 701.2 (Magnetism: Basic Concepts & Phenomena)

722 (Computer Hardware); 708 (Electric & Magnetic Materials); 712 (Electronic & Thermionic Materials); 802 (Chemical Apparatus & Plants); 701 (Electricity & Magnetism); 921 (Applied Mathematics)

72 (COMPUTERS & DATA PROCESSING); 70 (ELECTRICAL ENGINEERING); 71 (ELECTRONICS & COMMUNICATIONS); 80 (CHEMICAL ENGINEERING); 92

2/9/15 (Item 1 from file: 94)

DIALOG(R)File 94:JICST-EPlus

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03974770 JICST ACCESSION NUMBER: 99A0234121 FILE SEGMENT: JICST-E  
**Advanced Research into Nanometer-Scale Devices. Tunnel Magnetoresistance in  
Double-Barrier Junction through Layered Ferromagnetic Nanoparticles.**

SAITO YOSHIAKI (1); INOMATA KOICHIRO (1); NAKAMURA SHIN'ICHI (1)

(1) Toshiba Corp.

Toshiba Rebyu(Toshiba Review), 1999, VOL.54,NO.2, PAGE.9-12, FIG.6, REF.9

JOURNAL NUMBER: F0360AAK ISSN NO: 0372-0462 CODEN: TORBA

UNIVERSAL DECIMAL CLASSIFICATION: 537.311.1:669 621.318.1

LANGUAGE: Japanese COUNTRY OF PUBLICATION: Japan

DOCUMENT TYPE: Journal

ARTICLE TYPE: Commentary

MEDIA TYPE: Printed Publication

ABSTRACT: We have developed a double-tunnel junction with two tunnel barriers and layered ferromagnetic nanoparticles sandwiched between the two tunnel barriers, for use as a new magnetoresistance(MR) material. A characteristic of this tunnel junction is that metallic bridging by **pinholes** is not liable to occur, because of the double junctions. The newly developed junction exhibited a large MR ratio with a small resistance at a low field at room temperature. Moreover, it was found that the bias and temperature dependencies of the MR ratio are low for the present junction structure. This material has potential applications in highly sensitive magnetoresistive heads and magnetic random access memories(MRAM ). (author abst.)

DESCRIPTORS: tunnel junction; nanostructure; magnetoresistance effect;

ferromagnet; dual structure; temperature dependence; direct voltage;

magnetic memory; insulating film; quantum size effect; fine particle

BROADER DESCRIPTORS: bonding and joining; structure; galvanomagnetic effect

; magnetic field effect; effect; magnetic substance; magnetic material;

material; dependence; voltage; memory(computer); equipment; membrane

and film; size effect; quantum effect; particle

CLASSIFICATION CODE(S): BM03033M; NA04040H

2/9/16 (Item 1 from file: 103)

DIALOG(R)File 103:Energy SciTec

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04529162 JP-99-001581; EDB-99-109841

**Title: Tunnel magnetoresistance in double-barrier junction through layered  
ferromagnetic nanoparticles**

Original Title: Kyojisei nano ryushiso wo kaishita niyu tunnel setsugo no  
jiki teiko

Author(s): Saito, Y.; Inomata, K.; Nakamura, S. (Toshiba Corp., Tokyo  
(Japan))

Source: Toshiba Rebyu (Toshiba Review) v 54:2. Coden: TORBAN ISSN:  
0372-0462

Publication Date: 1 Feb 1999 p 9-12

Document Type: Journal Article

Language: Japanese

Journal Announcement: EDB9924

Availability: Toshiba Corp., 1-1, Shibaura 1-chome, Minato-ku, Tokyo, Japan

Subfile: ETD (Energy Technology Data Exchange). NEDO (Japan (sent to  
DOE from))

US DOE Project/NonDOE Project: NP

Country of Origin: Japan

Country of Publication: Japan

Abstract: We have developed a double-tunnel junction with two tunnel barriers and layered ferromagnetic nanoparticles sandwiched between the two tunnel barriers, for use as a new magnetoresistance (MR) material. A characteristic of this tunnel junction is that metallic bridging by

**pinholes** is not liable to occur, because of the double junctions. The newly developed junction exhibited a large MR ratio with a small resistance at a low field at room temperature. Moreover, it was found that the bias and temperature dependencies of the MR ratio are low for the present junction structure. This material has potential applications in highly sensitive magnetoresistive heads and magnetic random access memories (**MRAM**). (author)

Descriptors: CRYSTAL DEFECTS; ELECTRIC CONDUCTIVITY; FERROMAGNETIC MATERIALS; MAGNETIC PROBES; MAGNETORESISTANCE; MEMORY DEVICES; MICROSTRUCTURE; SEMICONDUCTOR JUNCTIONS; TEMPERATURE DEPENDENCE; TUNNEL EFFECT

Broader Terms: CRYSTAL STRUCTURE; ELECTRIC CONDUCTIVITY; ELECTRICAL PROPERTIES; MAGNETIC MATERIALS; MATERIALS; PHYSICAL PROPERTIES; PROBES  
Subject Categories: 426000\* -- Engineering -- Components, Electron Devices & Circuits -- (1990-)

2/9/17 (Item 1 from file: 144)  
DIALOG(R) File 144:Pascal  
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13127418 PASCAL No.: 97-0109565

**Spin-dependent tunneling in HfO SUB 2 tunnel junctions**

PLATT C L; DIENY B; BERKOWITZ A E

Department of Physics and the Center for Magnetic Recording Research, University of California, San Diego, La Jolla, California 92093; University of California, San Diego/Center for Magnetic Recording Research 0401, La Jolla, California 92093; CEA/Departement de Recherche Fondamentale sur la Matiere Condensee, SP2M/NM, 38054 Grenoble Cedex 9, France; Department of Physics and the Center for Magnetic Recording Research, University of California, San Diego, La Jolla, California 92093

Journal: Applied physics letters, 1996-10-07, 69 (15) 2291-2293

ISSN: 0003-6951 CODEN: APPLAB Availability: INIST-10020

Document Type: P (Serial) ; A (Analytic)

Country of Publication: United States

Language: English

We identified reactively sputtered HfO SUB 2 as a particularly good material for making thin insulating barriers for spin-dependent tunnel junctions. This material allows one to form **pinhole**-free tunnel barriers with good transmission of the spin polarization of the tunneling electrons. Magnetic tunnel junctions consisting of a thin layer of HfO SUB 2 sandwiched between transition metal electrodes (Co and Fe, for instance) exhibit changes of tunnel resistance up to 30% at low temperature as a function of applied field. This effect can be used in a variety of magnetic field sensing applications or in **magnetic random access memory**. (c)  
1996 American Institute of Physics.

English Descriptors: Experimental study

Broad Descriptors: MIM junctions; Hafnium oxides; Tunnel effect; Spin; Polarization; Sputtered materials; Cobalt; Iron; Magnetic materials; Junction MIM; Hafnium oxide; Effet tunnel; Spin; Polarisation; Matériau pulverise; Cobalt; Fer; Matériau magnetique

French Descriptors: 7570; 8570K; 7340R; Etude experimentale

Classification Codes: 001B70E70; 001D03F10; 001B70C40R

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